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CHANGES IN SHOREBIRD AND EIDER ABUNDANCE IN THE RASMUSSEN LOWLANDS, NWT

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ABSTRACT.—Historical records of population numbers are almost entirely lacking for shorebirds and some species of waterfowl breeding in the Nearctic. In 1975 and 1976, ground surveys of breeding birds were undertaken in the Rasmussen Lowlands, Northwest Territories. We carried out similar censuses in the same area during the summers of 1994 and 1995. Weather conditions and methods were very similar during the two sets of surveys. For all years, we compared densities in different habitat types, as well as estimates for the entire region of total numbers of breeding Red Phalaropes (*Phalaropus fulicaria*), Pectoral Sandpipers, (*Calidris melanotos*), White-rumped Sandpipers (*C. fuscicollis*), Semipalmated Sandpipers (*C. pusilla*), Black-bellied Plovers (*Pluvialis squatarola*), American Golden-Plovers (*Pluvialis dominica*), Dunlin (*C. alpina*), Baird's Sandpipers (*C. bairdii*), and King Eiders (*Somateria spectabilis*). We found that breeding populations of Red Phalaropes, Black-bellied Plovers, American Golden-Plovers, and King Eiders in the 1990s had decreased substantially (76–87%) from their numbers in the 1970s. Numbers of other shorebird species did not decrease significantly (17–48%). Numbers of Black-bellied Plovers have apparently decreased at staging sites on the east coast of the United States and Canada. However, for American Golden-Plovers, there is no evidence of a decline on the east coast or in at least one other area in the eastern Nearctic. No other population information exists for Red Phalaropes breeding in the eastern Nearctic. Eider numbers appear to be decreasing throughout the Arctic. Possible reasons for declines are habitat changes in migratory staging sites and southern wintering areas. We need more consistent monitoring of arctic shorebirds in order to identify species with continual population declines. Further studies should emphasize Nearctic populations of species showing substantial declines in this study, examining consistency of decreases throughout the Nearctic, and reasons for such changes. *Received 9 Oct. 1997, accepted 15 May 1998.*

Very little historical information exists on population numbers of shorebirds breeding in the Nearctic. Since few species of shorebirds breeding in the northern hemisphere are considered in immediate danger of extinction, this might not appear to be cause for concern. However, several factors about the biology of these birds make them particularly vulnerable. Many species gather in very large numbers at specific and consistent staging sites each year, acquiring enough energy to fly to their next foraging site (Senner and Howe 1984). For example, flocks of more than 200,000 Semipalmated Sandpipers (*Calidris pusilla*) can be found in the Bay of Fundy during fall migration in July (Morrison and Harrington 1979, Hicklin 1987). Therefore, at any of these major migratory staging areas, a large portion of one or more populations are extremely vulnerable not only to some catastrophic event when the birds are present (such as an oil spill), but also to any permanent habitat changes at that staging site. A decline in food abundance, or even changes in timing of peak food availability, might result in birds being unable to successfully continue their flight. This would be particularly important in areas such as the Bay of Fundy where the birds must migrate large distances nonstop over oceans. Total loss of an important staging site to development, pollution, or even drought, could have very severe consequences to populations of these birds (Myers 1983, Morrison 1984, Senner and Howe 1984, Myers et al. 1987). Most shorebirds are highly dependent on wetland environments, both coastal and inland. Such habitats are among the most heavily affected by human activity. A considerable percentage of North and South American wetlands are at risk or have already been lost or degraded by industry, recreation, or agriculture (Dahl 1990, Gillispie et al. 1991, Canevari et al. 1998).

In terms of population stability, even small changes in survivorship of adult shorebirds

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apparently have greater consequences than variations in breeding productivity (Hitchcock and Gratto-Trevor 1997). These birds are fairly long-lived and have the potential to produce only a few young each year. Clutches typically consist of no more than four eggs, and in the Arctic, renesting after clutch loss is not common. For most shorebirds, no more than one brood is produced per year, and fledging success can be low (Evans and Pienkowski 1984). Therefore, conditions during migration and wintering are very important, and recovery after a major population decline could potentially be slow. Even species with large populations can crash and disappear very rapidly, as with the Eskimo Curlew (*Numenius borealis*) earlier this century (Gollop et al. 1986).

Most species of North American shorebirds breed almost entirely in the Arctic (Godfrey 1986), so we cannot use the Breeding Bird Surveys of the United States and southern Canada to monitor changes in their population numbers. A few studies have used trend analysis to look at population changes in shorebirds staging in eastern North America during migration (Howe et al. 1989, Morrison et al. 1994), and a very few studies have examined long-term population changes on the breeding grounds, usually in a small study area (e.g., Pattie 1990, Gratto-Trevor 1994, Hitchcock and Gratto-Trevor 1997). In this paper we describe a unique opportunity to examine long-term changes in numbers of shorebirds across a fairly large (7500 km^2) area of the Canadian Arctic.

In 1975 and 1976, ground surveys for shorebirds and other birds were carried out in the Rasmussen Lowlands, Northwest Territories, by McLaren and coworkers (1977). These studies were instigated because the area was on the route of the proposed Polar Gas Pipeline. The surveys demonstrated that the Rasmussen Lowlands supported a high diversity and density of breeding birds, particularly shorebirds. In 1994 and 1995, almost 20 years later, we were able to re-census the area and consider changes in the bird population between the mid 1970s and the mid 1990s. The purpose of this paper is to report changes in abundance of shorebirds and eiders between the 1970s and 1990s in the Rasmussen Lowlands, NWT, to determine if similar trends in population changes exist in other studies and areas for these species, and to discuss possible reasons for any major population changes. Eiders are included because there recently has been considerable concern expressed about their numbers throughout the Arctic (Dickson 1996, Turner et al. 1996).

STUDY AREA AND METHODS

Study area.—The Rasmussen Lowlands are situated in the central Canadian Arctic on the mainland coast, at the eastern side of the Rasmussen Basin (Fig. 1). The nearest settlement is Taloyoak, about 55 km north of the northern edge of the study area. In this isolated region, no major land use changes have occurred since the 1970s. Much of the area is flat and poorly drained with some eskers and rock outcrops. Numerous lakes and ponds are present, and tussocky tundra and sedge marshes are common. The most common shorebirds breeding in the area (in order of abundance in the 1990s) are Red Phalaropes (*Phalaropus fulicaria*), Pectoral Sandpipers, (*Calidris melanotos*), White-rumped Sandpipers (*C. fuscicollis*), Semipalmated Sandpipers (*C. pusilla*), Dunlin (*C. alpina*), American Golden-Plovers (*Pluvialis dominica*), Black-bellied Plovers (*Pluvialis squatarola*), and Baird's Sandpipers (*C. bairdii*). King Eiders (*Somateria spectabilis*) are also common breeders in the area.

Red Phalaropes are highly aquatic birds that breed in the mid to high Arctic, and winter in southern oceans (Cramp and Simmons 1983). Pectoral (Godfrey 1986, Parmalee 1992) and White-rumped (Godfrey 1986, Marchant et al. 1986) sandpipers are small polygynous shorebirds that winter primarily in mid to southern South America. Semipalmated Sandpipers, Dunlin, and Baird's sandpipers are small monogamous sandpipers. Semipalmated Sandpipers winter mainly in northern South America (Gratto-Trevor 1992), Dunlin along coasts of the United States and southern Canada (Warnock and Gill 1996), and Baird's Sandpipers primarily in the southern half of South America (Myers and Myers 1979). Black-bellied Plovers and American Golden-Plovers are both large monogamous plovers. Black-bellied Plovers winter in coastal areas from the United States to southern South America (Paulson 1995), while American Golden-Plovers migrate to the grasslands of central South America (Johnson and Connors 1996). Since King Eiders breed, stage, and winter in the north, there is less information about their population numbers than about many other species of waterfowl (Bellrose 1976, Godfrey 1986, Dickson 1996).

Methods.—Methods were similar during the 1970s and 1990s studies and should not have resulted in significant differences in population estimation. Overall, 20% of all 1990s plots were in the same location as 1970s transects. Plot locations in 1994 were chosen to provide a mixture of plots in the same location as 1970s transects as well as plots in various habitat types (as represented by different colors on the initial satel-

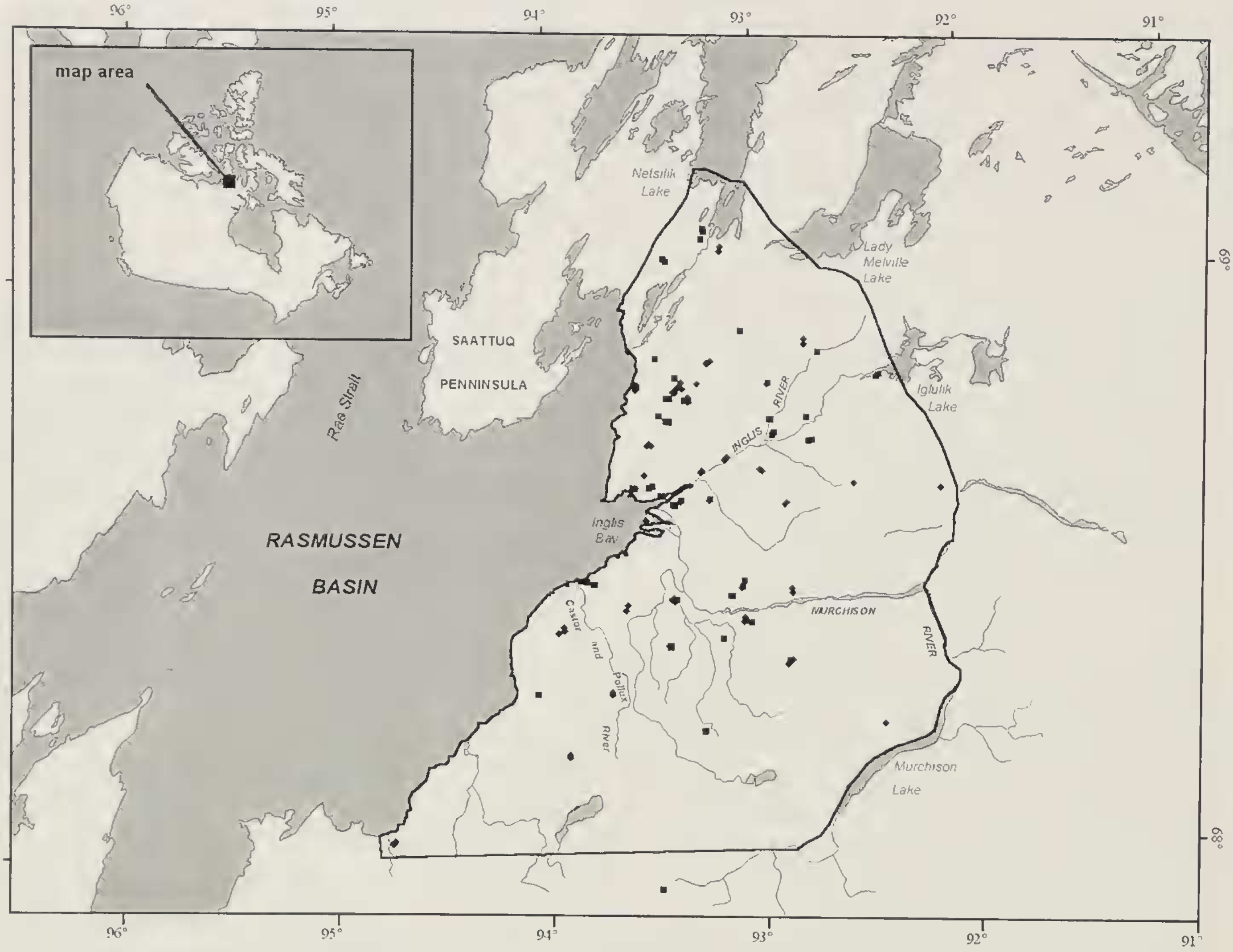

FIG. 1. Rasmussen Lowlands, NWT, study area.

lite imagery) spread throughout the study area (Fig. 1). Eleven 1994 plots were re-censused in 1995. Otherwise, plot locations in 1995 were selected to fill in geographic areas and habitats less well sampled the previous year. In both 1994 and 1995 we deliberately over-sampled sites with expected 'good' shorebird habitat, as identified by satellite imagery.

Censuses in the McLaren's and coworkers' (1977) study were transects 56 m wide and 933–9719 m long (for a total area of 14 km^2 over both years). Two people walked 28 m apart, so they would have been no farther than 14 m from any incubating bird. We used 400 × 400 m plots (a total of 21 km^2 over both years) censused by transects of 2 people walking 25 m apart. All parts of each plot were censused in this way, so we could have been no farther than 12.5 m from any incubating bird. Habitats and behavior of all birds, and their locations within and outside transects were noted in both studies. McLaren and coworkers (1977) described habitat variables at the start of the transect and every 130 m or when the habitat changed noticeably. We documented habitat variables at the start of the plot, every time the habitat changed noticeably, and drew maps of the extent of different habitats within each plot. On these field maps we also marked the location of each bird observed.

To make habitat types comparable for both studies, habitats were lumped into the following six categories: dwarf shrub tundra, with dwarf shrub and moss dominant, moist to dry soil, more than 50% cover [includes McLaren et al. (1977) dwarf shrub tundra open and closed phases]; graminoid/dwarf shrub tundra, with graminoids and dwarf shrub co-dominant, dry to moist soil, greater than 50% cover [McLaren et al. (1977) graminoid-dwarf shrub tundra open and closed phases]; low tundra, with graminoids, especially *Carex,* and moss dominant, soil saturated or with standing water, greater than 50% cover [McLaren et al. (1977) dry and wet *Carex* tundra open and closed phases, plus graminoid-lichen tundra closed phase]; moss tundra, with moss and lichen dominant, more than 80% plant cover, soil moisture dry to moist [McLaren et al. (1977) lichen-moss tundra closed phase]; sparse tundra, variable plant types and soil moisture but less than 50% plant cover, characterized primarily by a lack of vegetation [McLaren et al. (1977) sparse phases of lichen-moss tundra, graminoid-dwarf shrub tundra and dwarf shrub tundra]; and tussocky tundra, with cottongrass (*Eriophorum*) as the dominant plant, graminoids and moss dominant, and saturated soil to standing water, greater than 50% cover [McLaren et al. (1977) dry and wet cottongrass tundra closed phase]. Unvegetated ground was excluded from analyses, as virtually no birds were found there in either study.

Overall timing of the censuses was similar in both studies (1970s: 20 June to 17 July vs 1990s: 18 June to 13 July), encompassing much of the incubation and early brood-rearing periods of all birds present. Arctic weather can have extreme effects on the number of birds breeding in a year (Evans and Pienkowski 1984, Gratto-Trevor 1991). Weather conditions were also comparable between the studies, with each having apparently one year with warmer than usual summer weather (and early snow melt), and one year with colder than normal summer temperatures (and later snow melt; Johnston, Gratto-Trevor and Pepper, unpubl. data).

Only birds seen within the transect or plot areas were included in data analyses. Birds outside the area or flying overhead were noted but excluded from further analysis in both studies. Both excluded flocks of five or more birds. In both studies, large ponds and lakes were excluded from calculations of area searched. McLaren and coworkers (1977) calculated bird densities as the total number of birds of a species seen during censuses divided by the total land area searched (of that habitat, or total area) each year. We used weighted means of birds per area of habitat in each plot, and were therefore able to calculate 95% confidence limits around our mean densities. We back-checked and determined that these mean densities per habitat type each year for each species were virtually identical to densities obtained by dividing total birds seen during censuses by total area searched (of that habitat or total area) each year: McLaren's and coworkers' (1977) methods.

McLaren and coworkers (1977) sampled habitats in the same proportion that they existed in the study area. We used a stratified random design, where we concentrated on certain habitat types (those expected to contain the most birds) more than others. Since McLaren and coworkers (1977) felt that their transects represented an unbiased choice from the available habitat, they calculated their estimates of total population size by multiplying a species' density by the total area in the region. Because we deliberately oversampled some habitat types, we calculated our total population estimates by multiplying density in habitat 1 by total regional area of habitat 1 plus density in habitat 2 × total area of habitat 2 and so on. We determined total area of each habitat type in our study via Landsat Thematic Mapper analysis (Johnston, Gratto-Trevor and Pepper, unpubl. data). Our total study area (Fig. 1) was 77% of the area used by McLaren and coworkers (1977) for their total population estimates, so their totals were multiplied by 0.77 to adjust for the difference.

RESULTS

Because the densities and population estimates reported by McLaren and coworkers (1977) have no associated variance, we could not easily compare them statistically with our results. We decided to compare our numbers in two general ways: species densities in each habitat type, and overall population estimates.

Densities per habitat type.—For each of the eight most common shorebird species, and for King Eiders, we compared McLaren's and coworkers' (1977) and our densities in each of the six habitat types (Table 1). Both years of each study were combined because McLaren and coworkers (1977) presented their results in that form. If their species densities in a habitat type were above or below our 95% confidence limits for that habitat, we considered the difference significant. Red Phalarope density decreased significantly only in the low tundra habitat. All decreases (significant or not) were in habitats that contained the most phalaropes in the 1970s. On the other hand, Pectoral, Semipalmated, Baird's and White-rumped sandpipers did not show any significant changes between the 1970s and 1990s; nor did Dunlin. There were significant decreases of Black-bellied Plovers in low tundra and tussocky tundra habitats and significant decreases of American Golden-Plovers in low tundra and moss tundra. King Eider densities significantly declined from the 1970s to 1990s only in moss tundra.

Total population estimates.—We compared overall McLaren's and coworkers' (1977) population estimates each year with our mean estimates and 95% confidence limits for each species (Fig. 2). If their number was above or below our 95% confidence limits, we considered the difference significant. Only one year (1976) of ground survey information was available for King Eiders from the 1970s.

For Black-bellied Plovers, Red Phalaropes, and King Eiders, in all possible comparisons, 1990s upper 95% confidence limits were lower than the 1970s population estimates (Fig. 2). Although the population estimates of American Golden-Plovers were very low in both 1994 and 1995, 95% confidence limits were significantly lower than 1970s estimates only in 1995. In 1994 the variance was greater. The 1970s population estimates were always contained within the 1990s confidence estimates for Dunlin and Semipalmated Sandpipers, and the same was true in three of the four possible comparisons (1994 vs 1975 and 1976, 1995 vs 1975 and 1976) for Baird's

TABLE 1. Densities of shorebirds in different habitat types in the Rasmussen lowlands, NWT: 1975–1976 versus 1994–1995.

	Birds/km^2					
Years[a]	Dwarf shrub[b] tundra	Graminoid/dwarf shrub tundra	Low tundra	Moss tundra	Sparse tundra	Tussocky tundra
Red Phalarope						
1975/6	2	9	68	9	0	16
1994/5	3	2	12	9	3	3
Trend[c]	=	↓↓	↓↓↓	=	↑	↓↓
C.L. 1900s[d]	−3 to 8	−6 to 10	−4 to 27	−12 to 30	−8 to 13	−17 to 24
Significance[e]	—	—	*	—	—	—
Overall Trend: Decrease						
Pectoral Sandpiper						
1975/6	9	2	10	2	3	7
1994/5	5	6	6	4	2	6
Trend[c]	↓	↑	↓	↑	=	=
C.L. 1900s[d]	−5 to 15	−8 to 19	−2 to 15	−10 to 18	−3 to 6	−13 to 24
Significance[e]	—	—	—	—	—	—
Overall Trend: No Change						
White-rumped Sandpiper						
1975/6	7	6	6	7	0	2
1994/5	6	6	6	4	2	3
Trend[c]	=	=	=	↓	↑	=
C.L. 1900s[d]	−7 to 19	−13 to 24	−6 to 18	−7 to 16	−3 to 7	−27 to 34
Significance[e]	—	—	—	—	—	—
Overall Trend: No Change						
Semipalmated Sandpiper						
1975/6	1	2	4	0	6	1
1994/5	2	1	3	2	3	0
Trend[c]	=	=	=	↑	↓	=
C.L. 1900s[d]	−5 to 9	−2 to 4	−8 to 14	−5 to 10	−5 to 11	0
Significance[e]	—	—	—	—	—	—
Overall Trend: No Change						
Black-bellied Plover						
1975/6	7	2	5	0	0	5
1994/5	1	0	1	1	1	0
Trend[c]	↓↓	↓	↓↓	=	=	↓↓
C.L. 1900s[d]	−8 to 9	−1 to 2	−2 to 3	−2 to 3	−3 to 5	−1 to 2
Significance[e]	—	—	*	—	—	*
Overall Trend: Decrease						
American Golden-Plover						
1975/6	3	4	3	9	0	0
1994/5	3	2	1	1	0	0
Trend[c]	=	↓	↓	↓↓↓	=	=
C.L. 1900s[d]	−12 to 17	−2 to 5	−1 to 2	−6 to 8	0	0
Significance[e]	—	—	*	*	—	—
Overall Trend: Decrease						
Dunlin						
1975/6	0	2	0	0	0	1
1994/5	0	0	2	1	0	4
Trend[c]	=	↓	↑	=	=	↑
C.L. 1900s[d]	−2 to 3	−1 to 2	−2 to 5	−5 to 7	0	−8 to 17
Significance[e]	—	—	—	—	—	—
Overall Trend: No Change						

TABLE 1. CONTINUED

Years[a]	Birds/km² Dwarf shrub[b] tundra	Graminoid/ dwarf shrub tundra	Low tundra	Moss tundra	Sparse tundra	Tussocky tundra
Baird's Sandpiper						
1975/6	0	0	1	2	0	0
1994/5	0	1	0	1	1	0
Trend[c]	=	=	=	=	=	=
C.L. 1900s[d]	−1 to 2	−3 to 4	−1 to 2	−3 to 4	−4 to 6	0
Significance[e]	—	—	—	—	—	—
Overall Trend: No Change						
King Eider						
1975/6	1	3	4	4	0	2
1994/5	0	0	1	1	0	0
Trend[c]	=	↓	↓	↓	=	↓
C.L. 1900s[d]	−1 to 2	−3 to 4	−1 to 2	−3 to 4	−4 to 6	0
Significance[e]	—	—	—	*	—	—
Overall Trend: Decrease						

[a] Data from 1975 and 1976 are combined (from McLaren et al. 1977), as are data from 1994 and 1995.
[b] See text for description of habitats.
[c] Trend: '=' if change is 1 or 0, '↑' increase, '↓' decrease; the more arrows, the greater the change.
[d] C.L. 1990s: 95% confidence limits for 1994/5.
[e] Significance: '—' = 1970s value within 1990s 95% confidence limits; '*' = 1970s value outside 1990s 95% confidence limits.

Sandpipers, Pectoral Sandipers, and White-rumped Sandpipers (Fig. 2). Overall then, results were consistent with the previous density/habitat comparisons; in all species where there was a significant decrease in density per habitat between the 1970s and 1990s (which were also all species where more densities tended to go down than up), there were significant declines in overall numbers between the two time periods (Table 1, Fig. 2). Since overall population numbers were calculated from habitat densities, it is reassuring, but not particularly surprising, that results were consistent between overall numbers and density comparisons. Numbers of breeding Red Phalaropes, Black-bellied Plovers, American Golden-Plovers, and King Eiders (Fig. 2) apparently decreased significantly in the Rasmussen Lowlands between 1975/76 and 1994/95. Numbers of Pectoral Sandpipers, White-rumped Sandpipers, Semipalmated Sandpipers, Baird's Sandpipers, and Dunlin (Fig. 2) did not change significantly.

In the 1970s, 43% of the shorebirds seen in the area were Red Phalaropes (McLaren et al. 1977); in the 1990s this decreased to 27%. In terms of total population estimates, combining numbers from 1975 and 1976, and 1994 and 1995, the following declines were significant: Red Phalaropes decreased by 76%, Black-bellied Plovers by 87%, American Golden-Plovers by 79%, and King Eiders by 86%.

DISCUSSION

Validity of comparisons.—Methods were not identical for both time periods, and this may have resulted in differences in density and overall population estimates. If anything, this would have made our 1990s numbers higher, not lower. For example, a greater percentage of secretive birds (such as many species of nesting shorebirds) are missed in transects versus plot censuses (Edwards et al. 1981). Although the spread in timing of censuses is similar between the 1970s and the 1990s studies, a greater proportion of McLaren's and coworkers' (1977) ground surveys were carried out later in the season. This would result in relatively fewer birds being observed in the 1970s because of the early migration of failed breeders, nonbreeders, and nonincubating parents in uniparental species. Young of the year were not counted during the surveys in the 1970s or 1990s because

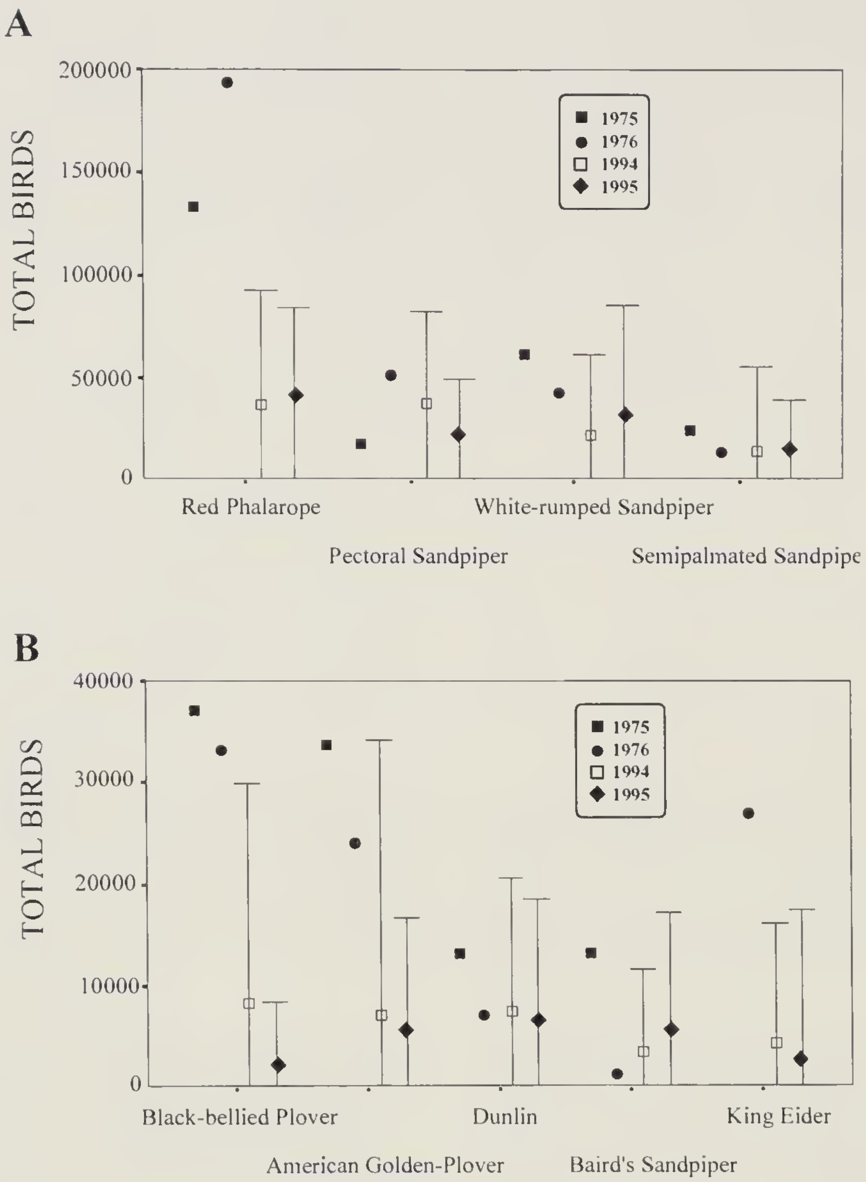

FIG. 2. Total estimated bird populations in 7500 km² area of Rasmussen Lowlands. Data from 1975 and 1976 were taken from McLaren and coworkers (1977). Bars around 1994 and 1995 data represent 95% confidence limits.

they were rarely seen before fledging, and very few fledged before the surveys ended. Groups of more than five birds were excluded from analysis in both studies, so few migrants were counted (Gratto-Trevor 1994, unpubl. data). Weather conditions in 1976 were apparently worse than either 1994 or 1995, again suggesting relatively lower numbers for the 1970s. There was no visual indication of habitat degradation from the 1970s to the 1990s, and no reason to expect any.

If McLaren and coworkers (1977) were incorrect in their assumption that their transects randomly surveyed the available habitat, they may have over or underestimated total population numbers. However, the habitat density results would not have been affected by such an error, and these data show significant declines in at least one habitat type for both species of large plovers, phalaropes, and eiders. This suggests that changes in numbers between the two time periods are not due to differences in methodology, and may be even greater than reported here.

Trends in other areas and possible reasons for declines.—For all of the species examined here, little information exists on changes in population numbers from other studies. However, for King Eiders, major declines have been noted in Alaska (Conant and Groves 1995), and numbers in the central and western Canadian Arctic appear to have decreased as well (Dickson et al. 1997). In the Rasmussen region itself, residents have expressed concern over decreasing eider numbers (K. McCormick, pers. comm.). Large decreases have been noted among eiders wintering in Greenland, but it is not known what percentage of King Eiders nesting in the Rasmussen Lowlands winter in Greenland, versus Labrador and Newfoundland. One reason suggested for the decline in King Eiders is overharvesting of eiders in Greenland and possibly Newfoundland and Labrador (Turner et al. 1996). However, reasons for the decline may not be specific to King Eiders. Global factors such as changes in marine conditions on wintering grounds may be affecting prey abundance for many seabird species (Goudie et al. 1994).

For Red Phalaropes, there is no indication of a population decline of Alaskan breeding populations (Troy 1996; D. Schamel, pers. comm.). Other than the current study, apparently no information exists for the central or eastern Nearctic. Large numbers of Red Phalaropes have historically staged off Brier Island, Nova Scotia, in the fall (Squires 1952, Brown 1980), and it is not known whether their numbers there have decreased recently (C. D. Duncan, pers. comm.; P. Hicklin, pers. comm.). Wintering areas of central and eastern Nearctic breeding Red Phalaropes are unverified, and no wintering trend information exists for this species. A major southeastern autumn migration of Nearctic populations has been suggested, with the birds wintering in upwellings of the Guinea and Canary currents off the bulge of Western Africa (Cramp and Simmons 1983). Red-necked Phalaropes (*Phalaropus lobatus*) are very similar to Red Phalaropes. Both are plankton feeders and highly aquatic, so similar factors might be expected to affect these two species. The many thousands of Red-necked Phalaropes that used to stage in the Bay of Fundy (Duncan 1995), and the large numbers historically found off Japan, no longer occur there (Rubega and Schamel, in press). No one knows why these populations have disappeared, nor is it known whether the birds have moved or died. The major wintering concentrations of Nearctic Red-necked Phalaropes are apparently in the Humboldt current off Peru, South America (Cramp and Simmons 1983).

Possible reasons for declines in populations of phalaropes are changes in abundance or availability of their plankton prey in staging or wintering areas. Global conditions may be affecting upwelling sites, where plankton are forced to the surface during daytime, becoming available for foraging phalaropes (Brown 1980, Cramp and Simmons 1983).

For Black-bellied Plovers, analysis of east coast staging areas revealed decreases that approached significance in their numbers during migration (for a cumulative decline of 46% over 12 years and 33% over 10 years, respectively; Howe et al. 1989, Morrison et al. 1994). No data exist from wintering areas. Bloodworm harvesting in the Bay of Fundy significantly decreased Black-bellied Plover foraging success (Shepherd 1994). However, bloodworm harvesting began too recently in Nova Scotia to have resulted in population declines, and harvesting in the eastern United States was not concentrated in important Black-bellied Plover foraging habitat (P. Shepherd, pers. comm.).

American Golden-Plovers increased during a long-term study on Devon Island, NWT, and no changes were noted in birds staging in eastern Canada (Pattie 1990, Morrison et al. 1994). No data exist from wintering areas, although some researchers have noted that considerable portions of the winter range are at risk to agriculture, and this might result ultimately in population declines (Johnson and Connors 1996).

Other than the fact that both Black-bellied Plovers and American Golden-Plovers are large plovers that migrate south relatively late in the fall, there seems little similarity between the two species that would explain the large decreases found in their populations at the Rasmussen Lowlands. It seems unlikely that hunting in South and Central America, or illegal hunting in eastern Canada and the United States could explain the decline (Johnson and Connors 1996), but shorebird mortality by hunting is largely undocumented (Senner and Howe 1984).

Conclusions.—We observed major declines in numbers of three species of shorebirds and in King Eiders between the mid 1970s and the mid 1990s. Reasons for these decreases are unclear, and they may be different for each species. In some cases, population declines in these species were observed during other studies as well. In other instances there were no changes elsewhere, or more often, no data. It is not known how consistent these changes are throughout even the eastern Nearctic, but the Rasmussen Lowlands are in themselves a large area, consisting of at least 7500 km^2. Since numbers were not censused between 1976 and 1994, we cannot be certain that the decreases represent a persistent and continuing decline. It is possible that they are natural fluctuations, perhaps the result of a series of recent poor breeding years. To determine whether population numbers again increase, or continue to decline, future researchers should recensus the area more frequently, perhaps every two years out of ten. More information must be obtained on population trends and factors affecting productivity and survival in this region as well as elsewhere in the Nearctic.

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